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Japanese Published Unexamined (Kokai) Patent Publication No. 60-095221; Publication Date: May 28, 1985; Application No. 58-203253; Application Date: October 29, 1983; Int. Cl.[4]: F16D 3/40; Inventor: Takayuki Matsushima; Applicant: Kyowa Sangyo K.K.; Japanese Title: Jizaijikutsugite (Adjustable Shaft Joint)

Specification

1. Title of Invention

Adjustable Shaft Joint

2. Claim

An adjustable shaft joint, being comprised of yokes on the driving side and the driven side and a cross-shaped spider, characterized in that synthetic resin having a low friction property is applied on a trunnion shaft unit of the spider; the trunnion shaft unit is engaged with and inserted in the inner surface of a cap; the cap is engaged with and fixed in a hole formed on the yoke.

3. Detailed Description of the Invention

This invention particularly pertains to an adjustable shaft joint that is used for a steering unit of a vehicle. More specifically, the invention relates to a bearing unit between a trunnion shaft unit and a yoke at an adjustable shaft joint generally called a cardan type.

A needle bearing is conventionally used for this type of adjustable shaft joint. For this reason, it is necessary to strictly control the surface hardness, roughness and size of

the trunnion shaft unit, resulting in an increased cost for the needle bearing in addition to the high price thereof per se and the complicated assembly thereof.

Accordingly, the inventor has proposed an adjustable shaft joint that uses a synthetic resin bearing (please see Japanese unexamined utility model application No.58-116824). Since the bearing device for the adjustable shaft joint is constructed by press-fitting the synthetic resin bearing in a cap, which is made from Derurin (the product name), a permanent distortion easily occurs to the resin bearing at the press-fitting. Because of the low friction property, which is a characteristic of a resin bearing, the bearing easily comes off from the cap. During the use of the bearing, a contact by rubbing with a vibration in the trunnion shaft direction is added other than a contact by rubbing with a rotation. As a result, early abrasion occurs to the bearing to cause a severe damage and to finally break it.

In addition, an adjustable shaft joint obtained such that a trunnion shaft unit is formed as a taper surface and that a synthetic resin bearing having a taper inner surface that is in contact with the taper surface in a rubbing fashion is provided while adding a proper precompression has been proposed (please see Japanese examined utility model application No.56-022029 and Japanese unexamined utility model application No.56-163820). Nevertheless, since the resin bearing is constituted with the taper inner surface, it is extremely difficult for it to be molded. The precision may be deteriorated more severely than that of the aforementioned cylindrical resin bearing. Thus, it is difficult to obtain a contact by rubbing with the entire taper surface of the trunnion. A local contact occurs. A grinding motion and a vibration may occur, which are not desirable for the trunnion.

Furthermore, as the adjustable shaft joint uses the synthetic resin bearing in lieu of the needle bearing. A bearing is still required. More specifically, an assembling cost for a bearing and the bearing and a complicated process are required. As a result, a higher cost reduction cannot be achieved.

The invention is produced in consideration of the above circumstances and aims to offer a highly reliable adjustable shaft joint with the aforementioned disadvantages eliminated, which maintains a predetermined precision for an extended period.

The adjustable shaft joint of the invention is characterized in that synthetic resin having a low friction coefficient is applied on a trunnion shaft unit of a spider, the trunnion shaft unit is engaged with and inserted in the inner surface of a cap, and that the cap is engaged with and fixed in a hole formed on the yoke.

The working examples of the invention are described hereinbelow along with the drawings.

As shown in Fig.1, an adjustable shaft joint 1 is comprised of a yoke 2 connected to a driving shaft, a yoke 3 connected to a driven shaft, and a cross-shaped spider 5. The spider 5 contains a trunnion shaft unit 6. Holes 7 are separately provided on the yoke 2 and 3. The trunnion shaft unit 6 is inserted in the holes 7 via a cap 9.

In addition, as shown in Fig.3 in detail, caulking claws 10 are formed in three locations around the holes 7 on the outer side surfaces of the yokes 2 and 3. As shown in Fig.4 in detail, an inner surface 9a that forms a conical frustum is formed on one side of the center of the cap 9 whereas a stepped projection 9b is formed on the closed section on the other side.

As shown in Fig.5 and Fig.6, the trunnion shaft unit 6 is shaped with a conical frustum, more specifically with a taper surface. Synthetic resin 11 having a low friction property is applied on the shaft unit 6, such as polyacetal, polyamide or polytetrafluoroethylene.

As shown in Fig.1 and Fig.2, an O-shaped ring 12 is inserted between the trunnion shaft unit 6 and a step 6a of the shaft unit 6 while the shaft unit 6 is placed inside the holes 7 of the yokes 2 and 3. The cap 9 is press-fit in the holes 7 of the yokes 2 and 3 while the trunnion shaft unit 6 is inserted into the inner surface 9a. At this state, the caulking claws 10 are brought into contact with a step b of the stepped projection 9b by a caulking means. By this means, the cap 9 is fixed to the yokes 2 and 3 while the synthetic resin surface 11 of the trunnion shaft unit 6 is engaged with the inner surface 9a by a rubbing means, thereby assembling the adjustable shaft joint 1. At the insertion of the trunnion shaft unit 6 in the inner surface 9a of the cap, a lubricant is preferably applied on the inner surface thereof in advance, such as grease, molybudenum disulfide or acetylene black. At the fixing of the cap 9 to the yokes 2 and 3, the claws 10 are preferably pressed and bent so that a proper precompression is given to the trunnion shaft unit 6.

As the working example is constituted as described above, a mutual rubbing and contacting motion occurs between the inner surface 9a and the synthetic resin surface 11 of the trunnion shaft unit 9. The synthetic resin 11 having the low friction property is readily applied on the shaft unit 6 at high precision after a powder thermal spraying and in some cases a polishing process have been applied. On the other hand, the cap 9 is uniformly brought into contact with an almost entire length of the shaft unit 6 and the inner surface 9a of the cap even though they are formed as a taper surface as it is

produced at high precision after a press process, a cutting process, or in some cases a vanish process or a cutting process has been applied. A smooth contact by rubbing is achieved without generating a grinding motion and a vibration. Moreover, since the shaft unit 6 and the inner surface 9a of the cap are formed as the taper surface, at the insertion of the shaft unit 6 in the inner surface 9a of the cap, the shaft unit can be easily inserted without compressing air in the back of the cap and accurately aligned. The performance can be continued for an extended period without having any damage in addition to a proper precompression.

As shown in Fig.7, a cavity 6b is formed on the entire circumference of the trunnion shaft unit 6. At an application of the synthetic resin 11, a part of the synthetic resin 11 is embedded in the cavity 6b to make the application thereof more reliable.

As shown in Fig.7 also, at an insertion of the cap 9 in the yoke holes 7, the insertion takes place in a loose fashion between the components. An elastic element 15 such as a washer is provided between a top 9c of the cap and a snap ring 13 engaged with the hole 7 by a contracting means. By these means, the proper precompression between the shaft unit 6 and the inner surface 9a of the cap can be maintained for an extended period.

As shown in Fig.8, the trunnion shaft unit 6 and the inner surface 9a of the cap can be formed in a cylindrical shape. In this case, the cap 9 can be readily and economically produced at a press process.

As described above, according to the invention, because the synthetic resin 11 having the low friction property is applied on the trunnion shaft unit 6, no bearing is required. Thereby, the number of components is reduced to achieve a drastic reduction of

the cost and to maintain predetermined performance as the trunnion shaft unit 6 is smoothly brought into contact with the inner surface 9a of the cap by a rubbing means. Furthermore, because the synthetic resin 11 is applied on the trunnion shaft unit 6, a load such as an impact is given to the shaft unit 6 so as to prevent a breakage of the resin layer 11. Since the synthetic resin application is easily formed at high precision, an alignment is accurately performed even if the shaft unit 6 and the inner surface 9a of the cap are formed as the taper surface. In addition, as the synthetic resin 11 is integrated with the shaft unit 6, undesirable motions such as a grinding motion and a vibration caused by a partial contact do not occur to the shaft unit 6. The predetermined precision is also maintained for an extended period. Putting these advantages together, a highly reliable adjustable shaft joint that can be readily and economically assembled and produced is obtained.

4. Brief Description of the Drawings

Fig.1 is a perspective view illustrating an adjustable shaft joint of the invention. Fig.2 is a cross-sectional view cut along a II-II surface. Fig.3 is a perspective view illustrating a part of a yoke. Fig.4 is a perspective view illustrating a cap. Fig.5 is a perspective view illustrating a trunnion shaft unit of a spider. Fig.6 illustrates the trunnion shaft unit. Fig.6 (a) is a vertical cross-sectional view thereof, and Fig.6 (b) a horizontal cross-sectional view cut along a bb line of Fig.6 (a). Fig.7 is a cross-sectional view illustrating a working example in which the contents are partially modified. Fig.8 is a cross-sectional view illustrating the other working example in which the contents are further modified.

1...Adjustable shaft joint

2 and 3...Yokes

5...Spider

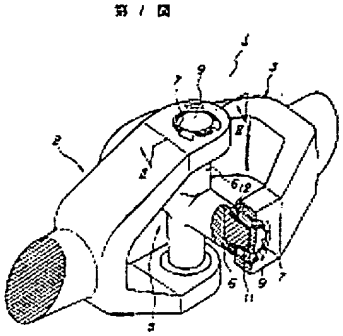
6...Trunnion shaft unit

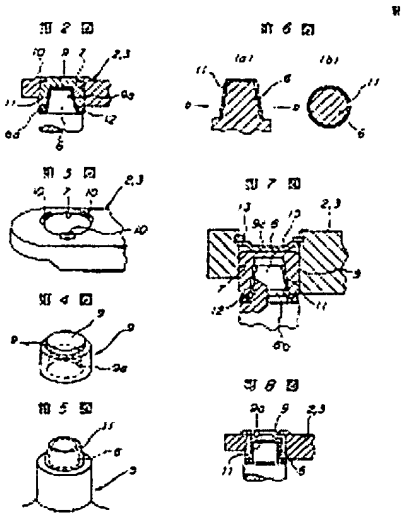
7...Holes

9...Cap

9a...Inner surface

11...Synthetic resin





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